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December 2002

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Abstract

Some researchers have studied the critical success factors in ERP implementations, out of which sustained management support is cited as the most one. Up to this moment, there is not enough research on the management and operationalization of critical success factors within ERP implementation projects. This paper presents a proposal for monitoring sustained management support in ERP implementations. In order to develop a set of metrics for such a monitoring task, we have used the goals/questions/metrics approach. As a result, we propose a GQM preliminary plan with different metrics to monitor and control sustained management support while implementing an ERP system.

Keywords: Enterprise Resource Planning, critical success factors, metrics, GQM, implementation, management support

Introduction

Nowadays, one of the paradigms within the enterprise information systems area is the implementation of Enterprise Resource Planning (ERP) systems. An ERP system is an integrated software package composed by a set of standard functional modules (production, sales, human resources, finance, etc.) developed or integrated by the vendor, that can be adapted to the specific needs of each customer. The current generation of ERP systems also provides reference models or process templates that claim to embody the current best business practices by supporting organizational business processes. Some researchers are using a critical success factors (CSFs) approach to study ERP implementations (Esteves and Pastor 2001). However, little has been done in relation to the management and the operationalization of these CSFs. Sustained management support is one of the most critical success factors (CSFs) in ERP implementation projects (e.g. Bancroft et al. 1998, Brown and Vessey 1999, Esteves and Pastor 2000, Holland et al. 1999, Nah et al. 2001, Welti 1999).

This study attempts to provide a set of metrics to help to control and monitor management support in ERP implementation projects in order to help managers to achieve success in their projects. According to Jurison (1999, p. 28) the purpose of project control is: "to keep the project on course and as close to the plan as possible, to identify problems before they happen and, implement recovery plans before unrecoverable damage is done". Al-Mashari and Zairi (2000, p. 308) pointed out that "having a comprehensive measurement system provides a feedback mechanism to track implementation efforts, identify gaps and deficiencies in performance, and recommended the necessary actions to fine-tune the situation in hand in order to achieve the desired business-centered outcomes".

Usually, the metrics proposed in ERP implementation methodologies are related with milestones and costs aspects. This is due to the fact that these methodologies follow the common definition of project success: on time and on budget. We used the Goals/Question/Metric (GQM) method to develop a relevant set metrics. The result of the application of this method is a GQM

plan. The GQM plan is a document that contains the goals, questions, and metrics for a measurement program (Solingen and Berghout 1999), in this case an ERP implementation project. This paper is organized as follows. First, we present the research approach used. Next, we present background in sustained management support. Then, we present a brief description of the GQM method and the GQM plan proposed. Finally, we present some conclusions and plans for further work.

Research Approach

The purpose of this study is to develop a set of metrics to help to control and monitor sustained management support in ERP implementation projects. We used the GQM method to develop a measurement plan. The steps of our research study were:

- Literature review related with sustained management support in ERP implementation projects.
- Definition of the preliminary GQM plan: definition of goals, definition of questions associated for each goal, definition of metrics associated to each question.

A literature review of sustained management support in information systems and ERP implementations was made in order to acquire knowledge related with this CSF. We used the concept of preliminary GQM plan due to the fact that the final GQM plan must be validated by the project team that is going to use it. Here, we only provide a proposal for this plan. The GQM plan model created in this research is based in Solingen and Berghout (1999) and the case studies they presented, in special in the case study D (effort measurement) described by Solingen and Berghout (1999, p. 177). Case study D describes a measurement plan to support a project team during a reorganization. This project team had to change from development to maintenance work.

Sustained Management Support

Green (1995) defines top management as the CEO and his/her direct subordinates all of them, responsible for corporate policy. Top management is represented in a project in the figure of the steering committee and the project sponsor. Welti (1999) considered a capable and powerful steering committee as absolutely crucial for a project, as it has to fulfil very important tasks and responsibilities, e.g. assuming ownership, managing the implementation of project policy, controlling project planning and progress, enabling fast decisions, deciding on organizational issues, making resources available, supporting the project manager, motivating the management. Project sponsor role is considered as another CSF in an ERP implementation. Therefore, it will be analyzed in the next phase of this research.

Esteves and Pastor (2000) stated that sustained management support is related with "sustained management commitment, both at top and middle levels during the implementation, in terms of their own involvement and the willingness to allocate valuable organizational resources. Management support is important for accomplishing project goals and objectives and aligning these with strategic business goals". Top management support is needed throughout the implementation project (Esteves and Pastor 2001, Nah et al. 2001) and it must be committed with its own involvement and willingness to allocate valuable resources to the implementation effort (Jarvenpaa and Ives 1991, Holland et al. 1999). Bingi et al. (1999) mention that “top management needs to constantly monitor the progress of the project and provide direction to the implementation teams”.

According to Purba et al. (1995, p. 178), top management has "an overall responsibility for accepting and approving the project initiatives outlined in the information technology strategic plan, including funding and prioritization of projects before they are initiated". In the context of small business, Yap et al. (1992) proposed and validated a measure of top management support. Their measure consists of: (1) level of support for the computerization project; (2) frequency of attendance at project meetings; (3) level of involvement in information requirements analysis; and (4) level of involvement in decision-making relating to the project. Next, we discuss the two main issues of sustained management support: support and commitment.

Management Support

According to Kraemmergaard and Moller (2000), “top management involvement is critical, while only top managers are equipped to act as the mediator between the imperative of the technology and the imperative of the organization”. One of the tasks of top management is to assist in project review meetings. According to (Jurison 1999, p. 31), the purpose of project review meetings is "to assess progress and identify areas of deviations from the plan so that corrective action can be taken". The author also states that project review meetings provide visibility to plans and progress and create opportunities for obtaining and enforcing commitments from the participants.

Welti (1999, p. 137) mentions that "active participation by upper management is crucial to the adequate resourcing of the project, to taking fast decisions, and to promoting company-wide acceptance of the project". Another important aspect is the recognition from top management that ERP implementations require the use of some of the best and brightest people in the organization for a notable period of time. Therefore, top management must help to identify these people, free them from other responsibilities, organize them into an interdisciplinary team, and empower them for the responsibility of the project (Chen 2001).

Management Commitment

Other important aspect is the commitment with the project. Top management needs to publicly and explicitly identify the project as a top priority (Wee 2000). Some view points of commitment are:

- Commitment to an information systems development project involves "doing what is necessary throughout the stages of system development, installation, and use to assure that the problem is understood and that the system development solves that problem" (Ginzberg 1981, p. 54).

- The Capability Maturity Model (CMM) defined commitment as "a pact that is freely assumed, visible, and expected to be kept by all parties" (CMU 1994).

- A more broad definition is given by O'Reilly and Chatman (1986). They view commitment as a psychological state of attachment that defines the relationship between a person and an entity. O'Reilly and Chatman (1986) described commitment as the degree to which an individual internalizes or adopts the goals and values of the organization.

- In another definition, commitment is described as "an individual's affective attachment to the goals and values of an organization, to (his or her) role in relation to these goals and values, and to the organization for its own sake apart from its purely instrumental worth to the individual (DeCotiis and Summers 1987).

Dong and Ivey (2000) defined two types of top commitment: commitment to resource and commitment to change management. Case studies on ERP systems suggest that the commitment of top management to resources is key to facilitating implementation processes (Hirt and Swanson 1999). Newman and Sabherwal (1996) identified the determinants of commitment in information systems development projects: project determinants, psychological determinants, social determinants and, structural determinants. They also proposed a model explaining the dynamics of commitment and how these determinants affect the levels of commitment. However, this model does not define these levels and it also does not take into account the research made by other authors related with commitment development such as Meyer and Allen (1991) and Conner and Patterson (1982). The management commitment development model to software process improvement proposed by Abrahamsson and Jokela (2000) takes into account these studies.

Based in an extensive literature review on the commitment topic, Meyer and Allen (1991) defined three forms of commitment:

- Affective commitment refers to the employee's attachment to, identification with, and involvement in the organization.
- Normative commitment reflects a feeling of obligation to continue membership with the organization.
- Continuance commitment refers to an awareness of the costs associated with leaving or abandoning the organization.

Meyer and Allen (1991) emphasize the need to consider these three forms of commitment as components of commitment rather than types of commitment. It means that an employee can experience all three forms of commitment with varying degrees. Other models for explaining commitment have been proposed, but Meyer and Allen (1991) model is the most used and validated. This is the main reason why we decided to adopt this model in our study since we did not find any study related with commitment in ERP implementation projects. We analyzed both three components in the ERP context:

Affective commitment is related with the involvement of top management in ERP project activities, as they show their identification with the project through the participation in the different project events showing that they share the project values. Top management commitment "when percolated down through the organizational levels results in an overall organizational commitment. An overall organizational commitment that is very visible, well defined, and felt is a sure way to ensure a successful implementation" (Bingi et al. 1999).

Normative commitment is related with the obligation to remain within the project. One of the CSFs in ERP implementation projects is the dedication of staff to the ERP project, since usually staff are not dedicated 100% for the project. They usually keep doing their normal activities in parallel. Chen (2001) says that top commitment must not be limited to the conception of the project (giving their blessing to the ERP system) but should continue through its completion. Their commitment implies that they are willing to spend significant amounts of time serving on the steering or executive committee, overseeing the implementation team. Continuance commitment is related with the costs associated with leaving or abandoning the project and the organization in some cases. This is an important point in ERP projects since one of the issues is the turnover of people in a project of this nature. Usually, the turnover affects more project team members and consultants.

Figure 1 represents a summary of the main concerns with top management support during ERP implementation projects. These concerns were based on the articles referenced in this work and the literature inside them. We categorized the different concerns in four dimensions: change management, process, people and project dimensions.

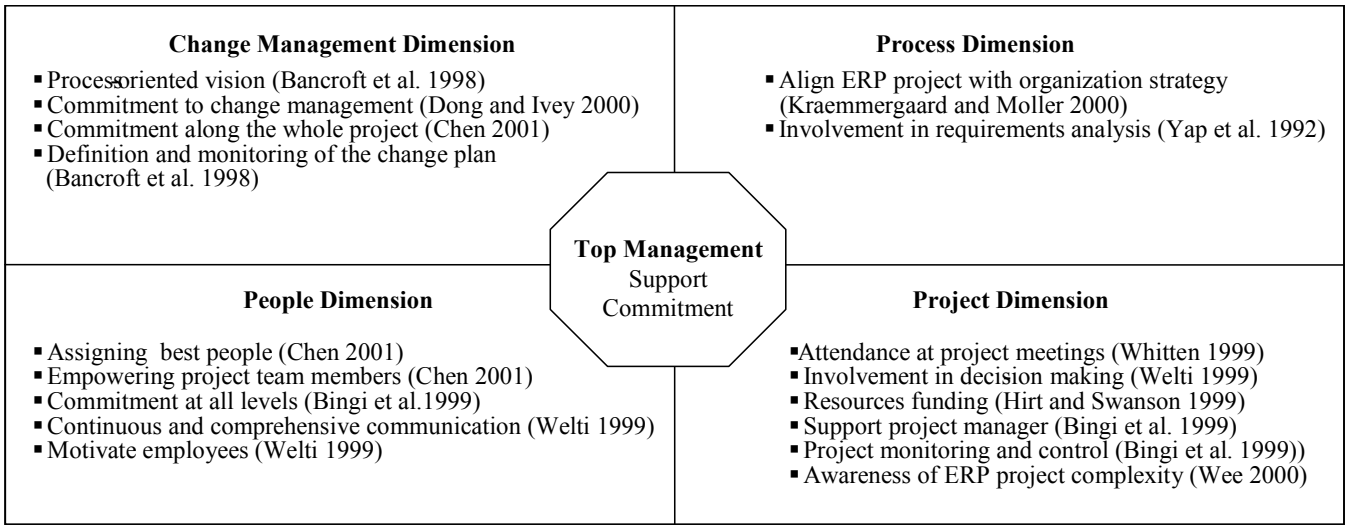

Figure 1. Top Management Concerns in the ERP Context

A GQM Preliminary Plan for Sustained Management Support

We present below an overview of GQM approach and then we describe each of the components of the GQM preliminary plan: measurement goals, questions and metrics. For each goal the following aspects are described: measurement goal description, its refinement into questions, and finally, the refinement from questions to metrics.

GQM Method Overview

The GQM approach is a mechanism that provides a framework for developing a metrics program. It was developed at the University of Maryland as a mechanism for formalizing the tasks of characterization, planning, construction, analysis, learning and feedback. GQM does not provide specific goals but rather a framework for stating measurement goals and refining them into questions to provide a specification for the data needed to help achieve the goals (Basili et al. 1994). The GQM method was originally developed by V. Basili and D. Weiss, and expanded with many other concepts by D. Rombach. GQM is a result of many years of practical experience and academic research. The GQM method contains four phases: planning phase, definition phase, data collection phase and interpretation phase, for more details see Solingen and Berghout (1999).

The definition phase is the second phase of the GQM process and concerns all activities that should be performed to formally define a measurement program. Definition phase has three important steps:

- Define measurement goals - Measurement goals should be defined in an understandable way and should be clearly structured. These measurement goals should be relevant to the business, represent strategic goals from management, and support high priority processes of the organization (Solingen and Berghout 1999).

- Define questions - Questions should be defined to support the interpretation of measurement goals. Questions are a refinement of measurement goals from an abstract level to an operational level, which is more suitable for interpretation. By answering questions, one should be able to conclude whether a measurement goal is reached or is being approached. As Solingen and Berghout (1999) state, the questions should be defined at an intermediate level of abstraction between the metrics and the measurement goals. The list of questions is developed through interviews.

- Define metrics - Once measurement goals are refined into a list of questions, metrics should be defined that provide all the quantitative information to answer the questions in a satisfactory way. The metrics defined must ensure that sufficient information should be available to answer the questions.

One of the most important outcomes of this phase is the GQM plan. A GQM plan or GQM model documents the refinement of a precisely specified measurement goal via a set of questions into a set of metrics. Thus, a GQM plan documents which metrics are used to achieve a measurement goal and why these are used - the questions provide the rationale underlying the selection of the metrics.

Measurement Goals of the GQM Preliminary Plan

In our case of sustained management support, the definition of measurement goals was made using the template provided by Basili et al. (1994). We defined two measurement goals based in our CSF: time spent on support activities (see section 3.1) and level of commitment (see section 3.2):

Goal 1

Analyse:	The time spent by top managers on support activities and review meetings
For the purpose of	Analyzing
With respect to	ERP implementation projects
From the viewpoint of	Project managers and their project teams
In the context of	Organizations under ERP initiatives

Goal 2

Analyse:	The support and commitment level of top managers
For the purpose of	Understanding
With respect to	ERP implementation projects
From the viewpoint of	Project managers and their project teams
In the context of	Organizations under ERP initiatives

Questions

For each measurement goal we defined a main question and then, we defined a set of sub-questions related with the measurement goal (see table 1). The question for measurement goal one focuses on identifying objective and quantifiable aspects that were related to the baseline characteristics of the support activities performed along the project. Top managers are involved in two main activities: support meetings and review meetings. The question for measurement goal two is related with the presence of top managers in the meetings and the actions they proposed along the ERP project, especially communication events.

Table 1. The Definition of Questions for Each Measurement Goal

Goal	Question	Sub-question
One	What are the main characteristics of the support activities?	1. In which way is the support meeting requested (phone, email, etc.)? 2. For which domain is the support requested? 3. How long do support meetings take on average? 4. How many support meetings were done per phase? 5. How many support meetings were cancelled? 6. How many support activities were postponed? 7. What is the attendance in support meetings? 8. How many review meetings were done per phase? 9. How many review meetings were cancelled? 10. How many review meetings were postponed? 11. What is the attendance in review meetings? 12. How long do review meetings take on average? 13. What is the frequency of review meetings? 14. Are reviews made speedy in decision processes? 15. What is the percentage of scheduled review meetings done per phase? 16. How many events did top management propose?
Two	What is the level of commitment?	1. What is the level of affective commitment? 2. What is the level of normative commitment? 3. What is the level of continuance commitment?

Description of Metrics

In this section we show the definition of each metric and the relationship between the questions defined above and the metrics (see table 2). We also represent graphically the relationships (see figure 2).

Table 2. The Definition of Metrics and their Relationship with Questions

1	Support meeting request medium	Q1.1
2	Domain for the support meeting	Q1.2
3	Duration of support meeting	Q1.3
4	Number of support meetings per phase	Q1.4
5	Support meetings cancelled in each phase	Q1.5
6	Support meetings postponed in each phase	Q1.6
7	Attendance on support meetings	Q1.7, Q2.1
8	Number of review meetings per phase	Q1.8
9	Review meetings cancelled in each phase	Q1.9
10	Review meetings postponed in each phase	Q1.10
11	Attendance on review meetings	Q1.11, Q2.1
12	Duration of the review meeting	Q1.12
13	Frequency of review meetings	Q1.13
14	Undertaken time in decision making	Q1.14, Q2.2
15	Percentage of scheduled review meetings versus review meetings done per phase	Q1.15
16	Number of events proposed by top managers	Q1.16, Q2.1
17	Level of involvement in information requirements analysis	Q2.2
18	Level of involvement in decision-making	Q2.2
19	Project turnover	Q2.3

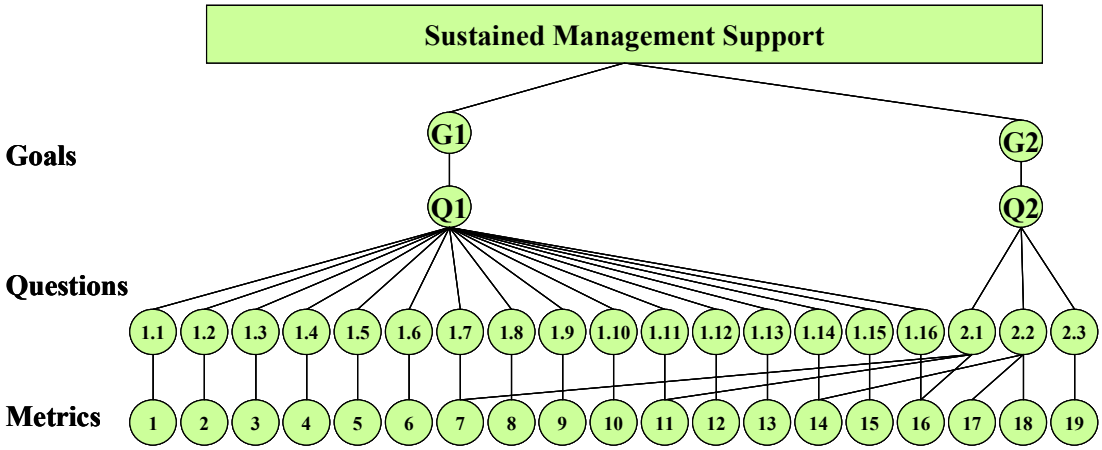

Figure 2. Graphical Representation of the GQM Preliminary Plan

The description of metrics was done by using a special form that we created for such task. For each metric we define the following aspects: what they are measuring, when they must be measured, what possible values they could have, the metric scale, who will measure it, what medium is used for data collection. Most of the metrics proposed are direct measurements except the metrics related with percentages.

Interpretation of Metrics

The metrics related with the first goal are concerned with the characteristics of the type of support that top managers do in an ERP implementation project. Therefore, metrics focus on the number of support and review meetings and topics related with attendance, and the number or meetings realized, cancelled or postponed. Review meetings are scheduled at the end of each implementation phase. Thus, we propose an analysis of metrics following the ERP implementation project phases. Esteves and Pastor (2001) shown that management support is more relevant at the beginning and at the end of the implementation project. The reason is that at the beginning, top management should help in the rollout of the project, analyze the business benefits, help to define the mission and scope of the project and provide the resources needed for the project. At the end, there is the need to encourage the system usage and help in the commitment of user involvement. Therefore it is important to control and monitor management support since the beginning in order to keep top managers committed with the project.

Cap Gemini (Cap Gemini 1996) made a survey to 220 European companies that have implemented SAP and they discovered that over 70% of the implementation teams reported only once a month or less to senior management. If you take into account that on average, the duration of an ERP implementation is some seven to twelve months, changes are being decided upon by senior leadership in fewer than ten meetings. Cap Gemini (1996) states that ten meetings is not enough time to ensure that all decisions are made in a thoughtful, deliberate, and well-informed manner. Therefore, they recommend a much stronger governance procedure.

Conclusions

This study attempts to define a first set of metrics for sustained management support in ERP implementation projects. Sustained management is cited as the most relevant CSF in ERP implementation projects. We think these metrics have two important proactive characteristics: metrics help to detect deviations from the project plan and to act before damage is made, and second, these metrics can have the effect of motivating and encouraging top managers in their involvement and commitment with the ERP implementation project. The results of this work are twofold. First, a GQM plan to monitor and control ERP implementation projects is presented and second, a literature review on top management support and commitment on ERP implementation projects.

This study only provides the first step to propose a set of metrics for sustained management support, i.e., the definition of the metrics. Next steps are the validation and interpretation of these metrics. Two possible kinds of validation methods can be applied: case study or control experiments (Calero et al. 2001). We would like to remark that we accept that this GQM preliminary plan

will be subject to changes during the next steps of the research due to new information gathered and experience gained in the feedback sessions. Another aspect is the importance of knowing the relevance of the sustained management support CSF along the stages of an implementation project (Esteves and Pastor 2001) due to the fact that this information can help managers to know when they should put more attention to specific metrics in each stage.

Currently, we are developing a software application for the management of the metrics defined here. Additional research will attempt to define metrics to other CSFs defined in the literature of ERP implementation projects. Along the literature review analysis we detected a lack of research in the management commitment topic in ERP implementation projects. Several studies have identified this topic as of major concern but no one has studied it in detail. Therefore, we think this topic is a topic that needs more attention in the future.

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